# Selected Acquisition Report (SAR)

RCS: DD-A&T(Q&A)823-456


# Next Generation Operational Control System (OCX)

As of FY 2017 President's Budget

Defense Acquisition Management
Information Retrieval
(DAMIR)

## Table of Contents

## Common Acronyms and Abbreviations for MDAP Programs

Acq O&M - Acquisition-Related Operations and Maintenance
ACAT - Acquisition Category
ADM - Acquisition Decision Memorandum
APB - Acquisition Program Baseline
APPN - Appropriation
APUC - Average Procurement Unit Cost
$B - Billions of Dollars
BA - Budget Authority/Budget Activity
Blk - Block
BY - Base Year
CAPE - Cost Assessment and Program Evaluation
CARD - Cost Analysis Requirements Description
CDD - Capability Development Document
CLIN - Contract Line Item Number
CPD - Capability Production Document
CY - Calendar Year
DAB - Defense Acquisition Board
DAE - Defense Acquisition Executive
DAMIR - Defense Acquisition Management Information Retrieval
DoD - Department of Defense
DSN - Defense Switched Network
EMD - Engineering and Manufacturing Development
EVM - Earned Value Management
FOC - Full Operational Capability
FMS - Foreign Military Sales
FRP - Full Rate Production
FY - Fiscal Year
FYDP - Future Years Defense Program
ICE - Independent Cost Estimate
IOC - Initial Operational Capability
Inc - Increment
JROC - Joint Requirements Oversight Council
$K - Thousands of Dollars
KPP - Key Performance Parameter
LRIP - Low Rate Initial Production
$M - Millions of Dollars
MDA - Milestone Decision Authority
MDAP - Major Defense Acquisition Program
MILCON - Military Construction
N/A - Not Applicable
O&M - Operations and Maintenance
ORD - Operational Requirements Document
OSD - Office of the Secretary of Defense
O&S - Operating and Support
PAUC - Program Acquisition Unit Cost

PB - President’s Budget
PE - Program Element
PEO - Program Executive Officer
PM - Program Manager
POE - Program Office Estimate
RDT&E - Research, Development, Test, and Evaluation
SAR - Selected Acquisition Report
SCP - Service Cost Position
TBD - To Be Determined
TY - Then Year
UCR - Unit Cost Reporting
U.S. - United States
USD(AT&L) - Under Secretary of Defense (Acquisition, Technology and Logistics)

## Program Information

**Program Name**

Next Generation Operational Control System (OCX)

**DoD Component**

Air Force

**Joint Participants**

Department of Transportation

## Responsible Office

Col Steven Whitney
483 N. Aviation Blvd
El Segundo, CA 90245

steven.whitney.1@us.af.mil

**Phone:** 310-653-3001
**Fax:** 310-653-3005
**DSN Phone:** 633-3001
**DSN Fax:** 633-3005
**Date Assigned:** July 8, 2015

## References

**SAR Baseline (Development Estimate)**

Defense Acquisition Executive (DAE) Approved Acquisition Program Baseline (APB) dated November 19, 2012

**Approved APB**

Defense Acquisition Executive (DAE) Approved Acquisition Program Baseline (APB) dated October 19, 2015

## Mission and Description

The Global Positioning System (GPS) is a space-based positioning, navigation, and timing distribution system, which operates through weather and electromagnetic environments (jamming, spoofing, etc.). GPS supports both civil and military users in air, space, sea, and land operations. GPS is a satellite-based radio navigation system that serves military and civil users worldwide. GPS users process satellite signals to determine accurate position, velocity, and time. GPS must comply with section 2281 of title 10, United States Code (USC), which requires that the Secretary of Defense ensures the continued sustainment and operation of GPS for military and civilian purposes and section 50112 of title 51, USC, which requires that GPS complies with certain standards and facilitates international cooperation.

The Next Generation Operational Control System (OCX) program develops and fields a modernized satellite command and control (C2) system which replaces the current ground control system for legacy and new GPS satellites. OCX implements a modern flexible architecture with built-in robust information assurance to address emerging cyber threats. The Air Force is taking a block approach to develop OCX with each block delivering upgrades as they become available.

The OCX program of record consists of two block deliverables: Block 1 and Block 2. OCX Block 0, a subset of Block 1, will allow OCX to support the launch and checkout of GPS III satellites. OCX Block 1 replaces the existing legacy GPS C2 system and fields the operational capability to control legacy satellites (GPS IIR, IIR-M, and IIF) and control existing signals (L1 C/A, L1P(Y), and L2P(Y)). OCX Block 1 also adds the operational capability to command and control the GPS III satellites and the modernized civil signals (L2C and L5). OCX Block 2 adds operational control of the new international open/civil L1C signal in compliance with 2004 European Union-United States agreement and adds control of the modernized Military Code signal.

## Executive Summary

Since the December 2014 SAR, the program has completed a new APB, dated October 19, 2015, and held two major Deep Dive reviews with USD(AT&L) to assess program performance and the way-ahead.

The Program Office and Raytheon initially held a Deep Dive with USD(AT&L) in February 2015. As a result of this Deep Dive, the MDA, in a May 23, 2015 ADM, directed the development of a new APB and established five tripwire milestones to measure schedule and cost performance.

An Acquisition Incident Review (AIR) board was conducted in July 2015 to identify root causes associated with OCX program execution challenges and provide recommendations for continuing the procurement of a modernized ground control system. The AIR identified 5 root causes which included an unrealistic program schedule at contract award; appropriate system engineering and system integration practices were not implemented by Raytheon at the start-up of the program; cybersecurity requirements were not clearly understood; a complex incentive structure; and high government personnel turnover. The Program Office and Raytheon have worked to address the root causes identified by the AIR board including applying lessons learned and correct software development practices to Block 1 software iterations; re-writing the incentive structure to simplify the criteria for award; and re-planning the program to a higher fidelity schedule.

A second Deep Dive occurred with USD(AT&L) on December 4, 2015 to re-assess program way-ahead as a result of several tripwire breaches. In support of this Deep Dive, the Deputy Assistant Secretary for Cost and Economics approved the December 1, 2015 SCP based upon a projected 47-month slip to the October 2015 APB. At the Deep Dive, OSD and the Air Force jointly agreed to a 24-month replan beyond the schedule objectives of Milestone C, Block 1 Ready to Transition to Operations (RTO) and Block 2 RTO in the October 2015 APB. On December 23, 2015 the Program Manager signed a Program Deviation Report declaring a 24-month slip past the current APB objectives of Milestone C, Block 1 RTO, and 2 RTO. The Air Force is in the process of completing an excursion to the December 2015 SCP for the 24-month replan. As part of the replan, the Department of Transportation (DoT) has a commitment to provide the Air Force $25.1M. The DoT funding is not a part of the SCP and is not included in the cost and funding tables.

During this period, Raytheon continued with Block 0 integration and test. Raytheon completed shipment of the Launch and Checkout System hardware on May 7, 2015 and completed installation activities at Schriever Air Force Base in August 2015. Raytheon completed 2 of 3 Configuration Item Qualification Test deficiency report (DR) re-test phases and has reduced the DR backlog from 261 to 138 in preparation for Test Readiness Review in CY 2016.

During this period, Raytheon continued efforts with Block 1 software development. An Iteration 1.6 Critical Design Review (iCDR) was conducted on July 30, 2015, with 11 liens assigned. A closure review was held on September 30, 2015, which resulted in 6 liens being passed and 5 deferred. The Program Office established a Delta iCDR to be held in Spring 2016 to close the remaining 5 liens. Raytheon has continued to make progress towards the Delta iCDR.

Of the 27 watch items reported in the previous SAR, 21 of those items have been closed with the additional 6 on-track to close.

On June 22, 2015, Raytheon notified the Program Office that four of the five tripwires were forecasted to be breached. The primary drivers for the breaches were late discovery of Information Assurance deficiencies, code growth as a result of correcting 635 system engineering gaps and resource contention between multiple critical tasks. On June 26, 2015, the Program Manager submitted notification to the PEO and the PEO submitted notification to the Service Acquisition Executive (SAE). The SAE notified the MDA on June 30, 2015 that Raytheon would breach four of the five tripwires for cost and schedule.

## Threshold Breaches

| APB Breaches | | |
|---|---|---|
| **Schedule** | | ☑ |
| **Performance** | | ☐ |
| **Cost** | RDT&E | ☐ |
| | Procurement | ☐ |
| | MILCON | ☐ |
| | Acq O&M | ☐ |
| **O&S Cost** | | ☐ |
| **Unit Cost** | PAUC | ☐ |
| | APUC | ☐ |

| Nunn-McCurdy Breaches | | |
|---|---|---|
| **Current UCR Baseline** | | |
| | PAUC | None |
| | APUC | None |
| **Original UCR Baseline** | | |
| | PAUC | None |
| | APUC | None |

**Explanation of Breach**

The schedule breach against the October 19, 2015 APB is a result of lack of appropriate system engineering and configuration management practices, information assurance requirements complexity, and an approximate 40% software code growth. The Air Force submitted a Program Deviation Report for the schedule breach on December 23, 2015.

The Air Force is currently replanning the OCX program based on a 24-month slip that was accepted at the December 4, 2015 Deep Dive with USD(AT&L).

## Schedule


| Schedule Events | | | | | |
|---|---|---|---|---|---|
| **Events** | **SAR Baseline Development Estimate** | **Current APB Development Objective/Threshold** | | **Current Estimate** | |
| Development Contract Award | Feb 2010 | Feb 2010 | Feb 2010 | Feb 2010 | |
| Block 1 and 2 PDR | Aug 2011 | Aug 2011 | Aug 2011 | Aug 2011 | |
| Milestone B | Nov 2012 | Nov 2012 | Nov 2012 | Nov 2012 | |
| Block 0 (LCS Delivery) | Nov 2014 | Apr 2016 | Oct 2016 | **Sep 2017**[1] | (Ch-1) |
| Milestone C | Oct 2015 | Jul 2018 | Jan 2019 | **Jul 2020**[1] | (Ch-2) |
| Block 1 RTO | Oct 2016 | Jul 2019 | Jul 2020 | **Jul 2021**[1] | (Ch-2) |
| Block 2 RTO | Jun 2017 | Jul 2020 | Jul 2021 | **Jul 2022**[1] | (Ch-2) |

[1] *APB Breach*

### Change Explanations

(Ch-1) The current estimate for Block 0 changed from February 2016 to September 2017 as a result of time required to resolve excessive deficiency reports.
(Ch-2) The current estimate for Milestone C changed from July 2018 to July 2020, the current estimate for Block 1 RTO changed from July 2019 to July 2021 and the current estimate for Block 2 RTO changed from July 2020 to July 2022 as a result of poor contractor performance.

### Notes

RTO will be achieved when the Control Segment can support GPS III SV01-10 and operational Block II satellites, can monitor broadcast GPS navigation signals, and can support NAVWAR mission planning by JSpOC. At RTO, the system is turned over to the operational community.

## Acronyms and Abbreviations

GPS - Global Positioning System
JSpOC - Joint Space Operations Center
LCS - Launch and Checkout System
NAVWAR - Navigation Warfare
PDR - Preliminary Design Review
RTO - Ready to Transition to Operations
SV - Space Vehicle

## Performance

| Performance Characteristics | | | | |
|---|---|---|---|---|
| **SAR Baseline Development Estimate** | **Current APB Development Objective/Threshold** | | **Demonstrated Performance** | **Current Estimate** |
| **Backward Compatibility** | | | | |
| All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS-GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifica-tions for the Local Area Augmenta-tion System, Wide Area Augmenta-tion System, Nationwide Differential GPS, and Maritime Differential GPS. | All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS-GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifica-tions for the Local Area Augmenta-tion System, Wide Area Augmenta-tion System, Nationwide Differential GPS, and Maritime Differential GPS. | (T=O) All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS -GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifica-tions for the Local Area Augmenta-tion System, Wide Area Augmenta-tion System, Nationwide Differential GPS, and Maritime Differential GPS. | TBD | All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS-GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifica-tions for the Local Area Augmenta-tion System, Wide Area Augmenta-tion System, Nationwide Differential GPS, and Maritime Differential GPS. |
| **Availability of Position Accuracy a. b. Horizontal c.d. Vertical** | | | | |
| UEE = 0.8 m rms a. 4.5 m (95%) @ 90% availability any lat/long b. 4.0 m (95%) @ 99.9% availability global average c. 7.0 m (95%) @ 90% availability any lat/long d. 7.0 m (95%) @ 99.9% availability global average UEE = 2.6 m rms a. 11.5 m | UEE = 0.8 m rms a. 4.5 m (95%) @ 90% availability any lat/long b. 4.0 m (95%) @ 99.9% availability global average c. 7.0 m (95%) @ 90% availability any lat/long d. 7.0 m (95%) @ 99.9% availability global average UEE = 2.6 m rms a. 11.5 m | a. 1.2 m (95%) @ 90% availability any lat/long b. 1.2 m (95%) @ 99.9% availability global average c. 1.9 m (95%) @ 90% availability any lat/long d. 1.9 m (95%) @ 99.9% availability global average Note: (a) and (c) values equal 1 m SEP Note: | TBD | UEE = 0.8 m rms a. 4.5 m (95%) @ 90% availability any lat/long b. 4.0 m (95%) @ 99.9% availability global average c. 7.0 m (95%) @ 90% availability any lat/long d. 7.0 m (95%) @ 99.9% availability global average UEE = 2.6 m rms a. 11.5 m |

| | | | | |
|---|---|---|---|---|
| (95%) @ 90% availability any lat/long b. 11.5 m (95%) @ 99.9% availability global average c. 17.7 m (95%) @ 90% availability any lat/long d. 17.7 m (95%) @ 99.9% availability global average. | (95%) @ 90% availability any lat/long b. 11.5 m (95%) @ 99.9% availability global average c. 17.7 m (95%) @ 90% availability any lat/long d. 17.7 m (95%) @ 99.9% availability global average. | no UEE assumed for objective because requirement is stated in FCS ORD. | | (95%) @ 90% availability any lat/long b. 11.5 m (95%) @ 99.9% availability global average c. 17.7 m (95%) @ 90% availability any lat/long d. 17.7 m (95%) @ 99.9% availability global average. |
| **Position and Time Transfer Integrity** | | | | |
| GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour. | GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour. | GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0000001 per hour. | TBD | GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour. |
| **Availability of Dynamic Time Transfer Accuracy** | | | | |
| UEE = 0.8 m rms Any lat/long 15 nanoseconds (ns) (95%) @ 90% availability Global Average 15 ns (95%) @ 99.9% availability UEE = 2.6 m rms Any lat/long 40 ns (95%) @ 90% availability Global Average 50 ns (95%) | UEE = 0.8 m rms Any lat/long 15 ns (95%) @ 90% availability Global Average 15 ns (95%) @ 99.9% availability UEE = 2.6 m rms Any lat/long 40 ns (95%) @ 90% availability Global Average 50 ns (95%) | Any lat/long 4.5 ns (95%) @ 90% availability Global Average 4.5 ns (95%) @ 99.9% availability Note: no UEE assumed for objective because requirement is derived from the FCS ORD Objective SEP accuracy requirement | TBD | UEE = 0.8 m rms any lat/long 15 ns (95%) @ 90% availability Global Average 15 ns (95%) @ 99.9% availability UEE = 2.6 m rms any lat/long 40 ns (95%) @ 90% availability Global Average 50 ns (95%). |
| **Availability of Static Time Transfer Accuracy** | | | | |
| 3.0 ns (95%) @ > 99.9% availability | 3.0 ns (95%) @ > 99.9% availability | 1.0 ns (95%) @ > 99.9% availability | TBD | 3.0 ns (95%) @ > 99.9% availability. |
| **Net-Ready KPP** | | | | |
| The system must fully support execution of joint critical operational activities and information exchanges identified in the DoD Enterprise Architecture and solution architectures based on integrated DoD AF content, and must satisfy the technical requirements for transition to Net-Centric military operations to include: 1) Solution architecture products compliant with DoD Enterprise Architecture | The system must fully support execution of joint critical operational activities and information exchanges identified in the DoD Enterprise Architecture and solution architectures based on integrated DoD AF content, and must satisfy the technical requirements for transition to Net-Centric military operations to include: 1) Solution architecture products compliant with DoD | The system must fully support execution of all operational activities and information exchanges identified in DoD Enterprise Architecture and solution architectures based on integrated DoD AF content, and must satisfy the technical requirements for transition to Net-Centric military operations to include 1) Solution architecture products compliant with DoD Enterprise | TBD | The system must fully support execution of joint critical operational activities and information exchanges identified in the DoD Enterprise Architecture and solution architectures based on integrated DoD AF content, and must satisfy the technical requirements for transition to Net-Centric military operations to include: 1) Solution architecture products compliant with DoD |

| | | | | |
|---|---|---|---|---|
| based on integrated DoD AF content, including specified operationally effective information exchanges 2) Compliant with Net-Centric Data Strategy, and Net-centric Services Strategy and the principles and rules identified in the DoD IEA, excepting tactical and non-IP communic-ations 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementa-tion guidance of GESPs necessary to meet all operational requirements specified in the DoD Enterprise Architecture and solution architecture views 4) Information assurance requirements including availability, integrity, authentica-tion, confidential-ity, and non-repudiation, and issuance of an IATO or ATO by the DAA, and 5) Support-ability requirements to include SAASM, Spectrum, and JTRS require-ments. | Enterprise Architecture based on integrated DoD AF content, including specified operationally effective information exchanges 2) Compliant with Net-Centric Data Strategy, and Net-centric Services Strategy and the principles and rules identified in the DoD IEA, excepting tactical and non-IP communic-ations 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementa-tion guidance of GESPs necessary to meet all operational requirements specified in the DoD Enterprise Architecture and solution architecture views 4) Information assurance requirements including availability, integrity, authentica-tion, confidential-ity, and non -repudiation, and issuance of an IATO or ATO by the DAA, and 5) Support-ability requirements to include SAASM, Spectrum, and JTRS require-ments. | Architecture based on integrated DoD AF content, including specified operationally effective information exchanges 2) Compliant with Net–Centric Data Strategy and Net-Centric Services Strategy, and the principles and rules identified in the DoD IEA, excepting tactical and non-IP communic-ations 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementa-tion guidance of GESPs, necessary to meet all operational requirements specified in the DoD Enterprise Architecture and solution architecture views 4) Information assurance requirements including availability, integrity, authentica-tion, confidential-ity, and non -repudiation, and issuance of an ATO by the DAA, and 5) Support-ability requirements to include SAASM, Spectrum and JTRS require-ments. | | Enterprise Architecture based on integrated DoD AF content, including specified operationally effective information exchanges 2) Compliant with Net-Centric Data Strategy, and Net-centric Services Strategy and the principles and rules identified in the DoD IEA, excepting tactical and non-IP communic-ations 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementa-tion guidance of GESPs necessary to meet all operational requirements specified in the DoD Enterprise Architecture and solution architecture views 4) Information assurance requirements including availability, integrity, authentica-tion, confidential-ity, and non -repudiation, and issuance of an IATO or ATO by the DAA, and 5) Support-ability requirements to include SAASM, Spectrum, and JTRS require-ments. |
| **Sustainment--Materiel Availability** | | | | |
| The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds. | The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds. | (T=O) The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds. | TBD | The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds. |

## Requirements Reference

GPS III CDD dated September 17, 2009

## Change Explanations

None

## Notes

This performance baseline is for OCX and was derived from the system-level CDD requirements. The GPS III program will track cost, schedule, and performance separately in its own APB.

## Acronyms and Abbreviations

AF - Air Force
ATO - Authority To Operate
DAA - Designated Approval Authority
FCS - Future Combat System
GESP - GIG Enterprise Service Profiles
GIG - Global Information Grid
GPS - Global Positioning System
IATO - Interim Authority to Operate
IAW - In Accordance With
IEA - Information Enterprise Architecture
IP - Internet Protocol
IS - Interface Specifications
IT - Information Technology
JTRS - Joint Tactical Radio System
lat - Latitude
long - Longitude
m - meter
MSI - Misleading Signal in Space Information
ns - nanosecond
rms - root-mean-square
SAASM - Selective Availability/Anti-Spoofing Module
SEP - Spherical Error Probable
SS - System Specifications
SV - Space Vehicle
TV - Technical View
UE - User Equipment
UEE - User Equipment Error

## Track to Budget

**RDT&E**

| Appn | | BA | PE | | |
|---|---|---|---|---|---|
| Air Force | 3600 | 07 | 0603421F | | |
| | **Project** | | **Name** | | |
| | 674993 | | GPS III | (Shared) | (Sunk) |
| Air Force | 3600 | 07 | 0603423F | | |
| | **Project** | | **Name** | | |
| | 67A021 | | Global Positioning System III - Operational Control Segment (OCX) | | |
| | 67A025 | | GPS Enterprise Integrator | | |

## Cost and Funding

## Cost Summary

| Total Acquisition Cost | | | | | | | |
|---|---|---|---|---|---|---|---|
| Appropriation | BY 2012 $M | | | BY 2012 $M | TY $M | | |
| | SAR Baseline Development Estimate | Current APB Development Objective/Threshold | | Current Estimate | SAR Baseline Development Estimate | Current APB Development Objective | Current Estimate |
| RDT&E | 3347.2 | 3839.3 | 4112.0 | 4056.5 | 3413.0 | 3964.4 | 4189.0 |
| Procurement | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Flyaway | -- | -- | -- | 0.0 | -- | -- | 0.0 |
| Recurring | -- | -- | -- | 0.0 | -- | -- | 0.0 |
| Non Recurring | -- | -- | -- | 0.0 | -- | -- | 0.0 |
| Support | -- | -- | -- | 0.0 | -- | -- | 0.0 |
| Other Support | -- | -- | -- | 0.0 | -- | -- | 0.0 |
| Initial Spares | -- | -- | -- | 0.0 | -- | -- | 0.0 |
| MILCON | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Acq O&M | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 3347.2 | 3839.3 | N/A | 4056.5 | 3413.0 | 3964.4 | 4189.0 |

**Current APB Cost Estimate Reference**

SCP dated November 10, 2014

**Confidence Level**

Confidence Level of cost estimate for current APB: 55%

The November 10, 2014 SCP for the OCX Program is at the mean of the cost estimate distribution. It takes into consideration all relevant program risks, providing sufficient resources to execute the program under normal conditions encountering average levels of technical, schedule, and programmatic risk and external interference.

| Total Quantity | | | |
|---|---|---|---|
| Quantity | SAR Baseline Development Estimate | Current APB Development | Current Estimate |
| RDT&E | 1 | 1 | 1 |
| Procurement | 0 | 0 | 0 |
| Total | 1 | 1 | 1 |

## Cost and Funding

## Funding Summary

| Appropriation Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FY 2017 President's Budget / December 2015 SAR (TY$ M) | | | | | | | | | |
| Appropriation | Prior | FY 2016 | FY 2017 | FY 2018 | FY 2019 | FY 2020 | FY 2021 | To Complete | Total |
| RDT&E | 2709.2 | 349.2 | 393.3 | 252.5 | 232.8 | 124.9 | 127.1 | 0.0 | 4189.0 |
| Procurement | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| MILCON | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Acq O&M | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| PB 2017 Total | 2709.2 | 349.2 | 393.3 | 252.5 | 232.8 | 124.9 | 127.1 | 0.0 | 4189.0 |
| PB 2016 Total | 2666.6 | 350.2 | 222.3 | 136.5 | 139.0 | 88.0 | 0.0 | 0.0 | 3602.6 |
| Delta | 42.6 | -1.0 | 171.0 | 116.0 | 93.8 | 36.9 | 127.1 | 0.0 | 586.4 |

**Funding Notes**

The current program identified in the FY 2017 PB is for $4.189B. In addition to that, the Department of Transportation (DoT) currently has a commitment to provide $25.1M in support of the program. This additional $25.1M is not part of the SCP and is not included in the cost and funding tables.

An assessment is currently underway which will lead to a formal restructure of the program. The changes to cost and schedule are not definitized at this point in time.

| Quantity Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 2017 President's Budget / December 2015 SAR (TY$ M) | | | | | | | | | | |
| Quantity | Undistributed | Prior | FY 2016 | FY 2017 | FY 2018 | FY 2019 | FY 2020 | FY 2021 | To Complete | Total |
| Development | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Production | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PB 2017 Total | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| PB 2016 Total | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Delta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Cost and Funding

## Annual Funding By Appropriation

| Annual Funding<br>3600 \| RDT&E \| Research, Development, Test, and Evaluation, Air Force | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fiscal Year | Quantity | TY $M | | | | | |
| | | End Item Recurring Flyaway | Non End Item Recurring Flyaway | Non Recurring Flyaway | Total Flyaway | Total Support | Total Program |
| 2007 | -- | -- | -- | -- | -- | -- | 168.4 |
| 2008 | -- | -- | -- | -- | -- | -- | 249.5 |
| 2009 | -- | -- | -- | -- | -- | -- | 289.6 |
| 2010 | -- | -- | -- | -- | -- | -- | 288.4 |
| 2011 | -- | -- | -- | -- | -- | -- | 353.6 |
| 2012 | -- | -- | -- | -- | -- | -- | 347.0 |
| 2013 | -- | -- | -- | -- | -- | -- | 316.7 |
| 2014 | -- | -- | -- | -- | -- | -- | 361.4 |
| 2015 | -- | -- | -- | -- | -- | -- | 334.6 |
| 2016 | -- | -- | -- | -- | -- | -- | 349.2 |
| 2017 | -- | -- | -- | -- | -- | -- | 393.3 |
| 2018 | -- | -- | -- | -- | -- | -- | 252.5 |
| 2019 | -- | -- | -- | -- | -- | -- | 232.8 |
| 2020 | -- | -- | -- | -- | -- | -- | 124.9 |
| 2021 | -- | -- | -- | -- | -- | -- | 127.1 |
| Subtotal | 1 | -- | -- | -- | -- | -- | 4189.0 |

| Annual Funding<br>3600 \| RDT&E \| Research, Development, Test, and Evaluation, Air Force | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fiscal Year | Quantity | BY 2012 $M | | | | | |
| | | End Item Recurring Flyaway | Non End Item Recurring Flyaway | Non Recurring Flyaway | Total Flyaway | Total Support | Total Program |
| 2007 | -- | -- | -- | -- | -- | -- | 181.1 |
| 2008 | -- | -- | -- | -- | -- | -- | 263.0 |
| 2009 | -- | -- | -- | -- | -- | -- | 301.2 |
| 2010 | -- | -- | -- | -- | -- | -- | 296.2 |
| 2011 | -- | -- | -- | -- | -- | -- | 356.5 |
| 2012 | -- | -- | -- | -- | -- | -- | 343.6 |
| 2013 | -- | -- | -- | -- | -- | -- | 308.7 |
| 2014 | -- | -- | -- | -- | -- | -- | 347.6 |
| 2015 | -- | -- | -- | -- | -- | -- | 318.5 |
| 2016 | -- | -- | -- | -- | -- | -- | 327.5 |
| 2017 | -- | -- | -- | -- | -- | -- | 361.9 |
| 2018 | -- | -- | -- | -- | -- | -- | 228.1 |
| 2019 | -- | -- | -- | -- | -- | -- | 206.1 |
| 2020 | -- | -- | -- | -- | -- | -- | 108.4 |
| 2021 | -- | -- | -- | -- | -- | -- | 108.1 |
| Subtotal | 1 | -- | -- | -- | -- | -- | 4056.5 |

## Low Rate Initial Production

There is no LRIP for this program.

## Foreign Military Sales

None

## Nuclear Costs

None

## Unit Cost

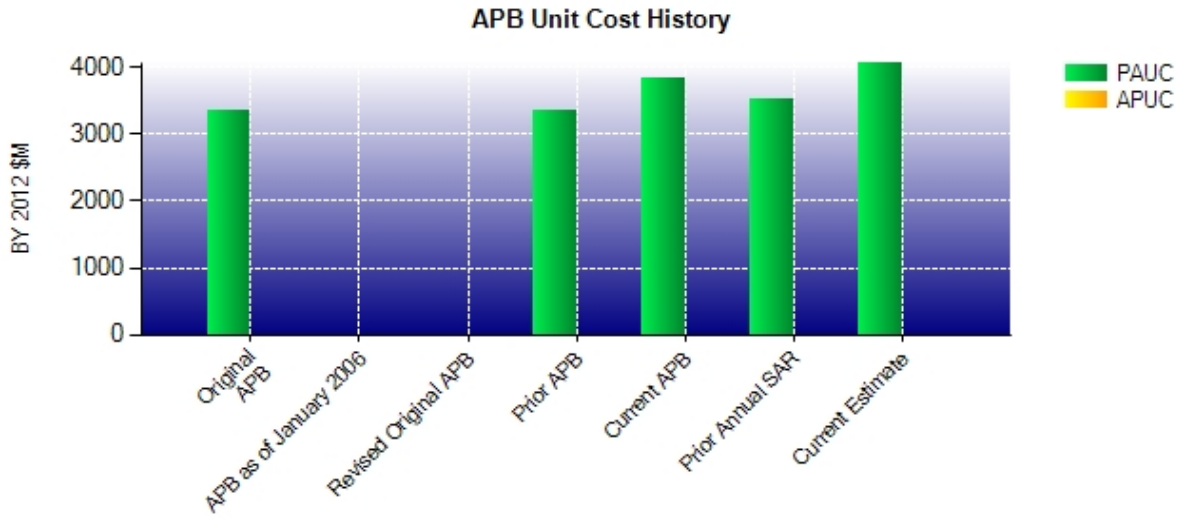
### Unit Cost Report

| Item | BY 2012 $M Current UCR Baseline (Oct 2015 APB) | BY 2012 $M Current Estimate (Dec 2015 SAR) | % Change |
|---|---|---|---|
| Program Acquisition Unit Cost | | | |
| Cost | 3839.3 | 4056.5 | |
| Quantity | 1 | 1 | |
| Unit Cost | 3839.300 | 4056.500 | +5.66 |
| Average Procurement Unit Cost | | | |
| Cost | 0.0 | 0.0 | |
| Quantity | 0 | 0 | |
| Unit Cost | -- | -- | -- |

| Item | BY 2012 $M Original UCR Baseline (Nov 2012 APB) | BY 2012 $M Current Estimate (Dec 2015 SAR) | % Change |
|---|---|---|---|
| Program Acquisition Unit Cost | | | |
| Cost | 3347.2 | 4056.5 | |
| Quantity | 1 | 1 | |
| Unit Cost | 3347.200 | 4056.500 | +21.19 |
| Average Procurement Unit Cost | | | |
| Cost | 0.0 | 0.0 | |
| Quantity | 0 | 0 | |
| Unit Cost | -- | -- | -- |

PAUC is based on RDT&E costs and quantities only. There is no APUC for this program because there are no procurement funds or quantities.

## Unit Cost History




| Item | Date | BY 2012 $M | | TY $M | |
|---|---|---|---|---|---|
| | | PAUC | APUC | PAUC | APUC |
| Original APB | Nov 2012 | 3347.200 | N/A | 3413.000 | N/A |
| APB as of January 2006 | N/A | N/A | N/A | N/A | N/A |
| Revised Original APB | N/A | N/A | N/A | N/A | N/A |
| Prior APB | Nov 2012 | 3347.200 | N/A | 3413.000 | N/A |
| Current APB | Oct 2015 | 3839.300 | N/A | 3964.400 | N/A |
| Prior Annual SAR | Dec 2014 | 3521.000 | N/A | 3602.600 | N/A |
| Current Estimate | Dec 2015 | 4056.500 | N/A | 4189.000 | N/A |

### SAR Unit Cost History

| Current SAR Baseline to Current Estimate (TY $M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Initial PAUC Development Estimate | Changes | | | | | | | | PAUC Current Estimate |
| | Econ | Qty | Sch | Eng | Est | Oth | Spt | Total | |
| 3413.000 | -25.800 | 0.000 | 0.000 | 0.000 | 801.800 | 0.000 | 0.000 | 776.000 | 4189.000 |

| Current SAR Baseline to Current Estimate (TY $M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Initial APUC Development Estimate | Changes | | | | | | | | APUC Current Estimate |
| | Econ | Qty | Sch | Eng | Est | Oth | Spt | Total | |
| 0.000 | -- | -- | -- | -- | -- | -- | -- | -- | 0.000 |

An APUC Unit Cost History is not available, since no Initial APUC Estimate had been calculated due to a lack of defined quantities.

| SAR Baseline History | | | | |
|---|---|---|---|---|
| Item | SAR Planning Estimate | SAR Development Estimate | SAR Production Estimate | Current Estimate |
| Milestone A | N/A | N/A | N/A | N/A |
| Milestone B | N/A | Nov 2012 | N/A | Nov 2012 |
| Milestone C | N/A | Oct 2015 | N/A | Jul 2020 |
| IOC | N/A | N/A | N/A | N/A |
| Total Cost (TY $M) | N/A | 3413.0 | N/A | 4189.0 |
| Total Quantity | N/A | 1 | N/A | 1 |
| PAUC | N/A | 3413.000 | N/A | 4189.000 |

## Cost Variance

| Summary TY $M | | | | |
|---|---|---|---|---|
| **Item** | **RDT&E** | **Procurement** | **MILCON** | **Total** |
| SAR Baseline (Development Estimate) | 3413.0 | -- | -- | 3413.0 |
| Previous Changes | | | | |
| Economic | -14.6 | -- | -- | -14.6 |
| Quantity | -- | -- | -- | -- |
| Schedule | -- | -- | -- | -- |
| Engineering | -- | -- | -- | -- |
| Estimating | +204.2 | -- | -- | +204.2 |
| Other | -- | -- | -- | -- |
| Support | -- | -- | -- | -- |
| Subtotal | +189.6 | -- | -- | +189.6 |
| Current Changes | | | | |
| Economic | -11.2 | -- | -- | -11.2 |
| Quantity | -- | -- | -- | -- |
| Schedule | -- | -- | -- | -- |
| Engineering | -- | -- | -- | -- |
| Estimating | +597.6 | -- | -- | +597.6 |
| Other | -- | -- | -- | -- |
| Support | -- | -- | -- | -- |
| Subtotal | +586.4 | -- | -- | +586.4 |
| Total Changes | +776.0 | -- | -- | +776.0 |
| CE - Cost Variance | 4189.0 | -- | -- | 4189.0 |
| CE - Cost & Funding | 4189.0 | -- | -- | 4189.0 |

| Summary BY 2012 $M | | | | |
|---|---|---|---|---|
| Item | RDT&E | Procurement | MILCON | Total |
| SAR Baseline (Development Estimate) | 3347.2 | -- | -- | 3347.2 |
| Previous Changes | | | | |
| Economic | -- | -- | -- | -- |
| Quantity | -- | -- | -- | -- |
| Schedule | -- | -- | -- | -- |
| Engineering | -- | -- | -- | -- |
| Estimating | +173.8 | -- | -- | +173.8 |
| Other | -- | -- | -- | -- |
| Support | -- | -- | -- | -- |
| Subtotal | +173.8 | -- | -- | +173.8 |
| Current Changes | | | | |
| Economic | -- | -- | -- | -- |
| Quantity | -- | -- | -- | -- |
| Schedule | -- | -- | -- | -- |
| Engineering | -- | -- | -- | -- |
| Estimating | +535.5 | -- | -- | +535.5 |
| Other | -- | -- | -- | -- |
| Support | -- | -- | -- | -- |
| Subtotal | +535.5 | -- | -- | +535.5 |
| Total Changes | +709.3 | -- | -- | +709.3 |
| CE - Cost Variance | 4056.5 | -- | -- | 4056.5 |
| CE - Cost & Funding | 4056.5 | -- | -- | 4056.5 |

Previous Estimate: December 2014

| RDT&E | $M | |
|---|---|---|
| Current Change Explanations | Base Year | Then Year |
| Revised escalation indices. (Economic) | N/A | -11.2 |
| Revised Estimate for Below Threshold Requirement from Space and Missile Systems Center Civilian Pay. (Estimating) | +6.9 | +7.1 |
| Revised Estimate in support of cost overruns associated with Block 0, 1, and 2 technical issues. (Estimating) | +488.4 | +548.3 |
| Revised Estimate for Above Threshold Requirement related to the OCX cost overruns for Block 0, 1, and 2 technical issues. (Estimating) | +42.7 | +44.8 |
| Realignment of funds for Small Business Innovation Research in FY 2015. (Estimating) | -8.9 | -9.3 |
| Adjustment for current and prior escalation. (Estimating) | +6.4 | +6.7 |
| RDT&E Subtotal | +535.5 | +586.4 |

# Contracts

## Contract Identification

**Appropriation:** RDT&E
**Contract Name:** OCX Phase B Contract
**Contractor:** Raytheon (Intelligence and Information Systems)
**Contractor Location:** 16800 E Centre Tech Pkwy
Aurora, CO 80011
**Contract Number:** FA8807-10-C-0001
**Contract Type:** Cost Plus Award Fee (CPAF)
**Award Date:** February 25, 2010
**Definitization Date:** February 25, 2010

| Contract Price | | | | | | | |
|---|---|---|---|---|---|---|---|
| Initial Contract Price ($M) | | | Current Contract Price ($M) | | | Estimated Price At Completion ($M) | |
| Target | Ceiling | Qty | Target | Ceiling | Qty | Contractor | Program Manager |
| 886.4 | N/A | 1 | 1714.3 | N/A | 1 | 1956.0 | 1979.0 |

## Target Price Change Explanation

The difference between the Initial Contract Price Target and the Current Contract Price Target is due to recognized cost over-runs as a result of software development and systems engineering challenges. Engineering Change Proposals, Requests for Equitable Adjustments, and engineering studies were also contributors.

| Contract Variance | | |
|---|---|---|
| Item | Cost Variance | Schedule Variance |
| Cumulative Variances To Date (10/20/2015) | -88.2 | -37.3 |
| Previous Cumulative Variances | -25.5 | -15.6 |
| Net Change | -62.7 | -21.7 |

## Cost and Schedule Variance Explanations

The unfavorable net change in the cost variance is due to an underestimated decomposition of activities and closure of items required to satisfy entry criteria for Iteration 1.6 Critical Design Review (iCDR) milestone; increased efforts for Technical Interface Meeting support, Peer Reviews, closure of 1.6 Integration Segment Design Walkthrough, Segment Element Freeze Review, 1.6; retention of senior staff to complete Action Items, Technical Requests, Discrepancy Reports, Change Requests as well as government identified issues for 1.6 iCDR; ongoing OCX Monitor Station Receiver Element engineering support for Material Review Board, Failure Review Board, Manufacturing Instructions, Re-Work Orders and Out of Band Interference resolution. Additionally, specific to Block 0, Raytheon continues to discover high defect density reports as well as the need for additional software builds and deployment needed to achieve software maturity.

The unfavorable net change in the schedule variance is due to various delays in the following areas: 1.5 Risk Reduction Integration and Test which caused a 9 month delay to system engineering, iteration 1.6 Software development due to delays in detailed design and risk reduction testing, GPS System Simulator qualification due to 1.6 SW delay and Master Control Station integration blocking discrepancy reports, start of downstream Block 0 factory testing due to software maturity and configuration items readiness, as well as late receipt of Block 1 Monitor Station, Supplier and material quality issues delaying planned assembly and test.

## Notes

The OCX current program performance baseline is no longer representative or useful in effective management of the program. The OCX program has authorized the implementation of an Over Target Baseline/Over Target Schedule (OTB/OTS) which will facilitate effective performance management of the GPS OCX program. During this reporting period all earned value reporting was rejected due to forecast realism and new direction provided by OSD. Starting February 2016, the program suspended EVM reporting on the current contractual baseline and tailored their monthly deliveries to report to the proposed current baseline that is being established during the OTB/OTS process. Upon completion of the OTB/OTS the program will establish an approved executable baseline and at that time the program will resume reporting at per the contractual EVM requirements.

For tracking purposes, initial contract price information is based on the initial monthly contractor's performance report ending March 28, 2010.

## Deliveries and Expenditures

| Deliveries | | | | |
|---|---|---|---|---|
| **Delivered to Date** | **Planned to Date** | **Actual to Date** | **Total Quantity** | **Percent Delivered** |
| Development | 0 | 0 | 1 | 0.00% |
| Production | 0 | 0 | 0 | -- |
| Total Program Quantity Delivered | 0 | 0 | 1 | 0.00% |

| **Expended and Appropriated (TY $M)** | | | |
|---|---|---|---|
| Total Acquisition Cost | 4189.0 | Years Appropriated | 10 |
| Expended to Date | 2459.2 | Percent Years Appropriated | 66.67% |
| Percent Expended | 58.71% | Appropriated to Date | 3058.4 |
| Total Funding Years | 15 | Percent Appropriated | 73.01% |

The above data is current as of February 23, 2016.

# Operating and Support Cost

## Cost Estimate Details

| | |
|---|---|
| **Date of Estimate:** | November 10, 2014 |
| **Source of Estimate:** | SCP |
| **Quantity to Sustain:** | 1 |
| **Unit of Measure:** | System |
| **Service Life per Unit:** | 10.00 Years |
| **Fiscal Years in Service:** | FY 2019 - FY 2029 |

Estimated Costs are part of the Service Cost Estimate supported by the Air Force Cost Analysis Agency as part of the SCP completed in November 2014. The current cost estimate was updated and signed by Deputy Assistant Secretary (Cost and Economics) on November 10, 2014.

O&S costs includes operating, maintaining, and supporting the dedicated Master Control Station (MCS) located at Schriever Air Force Base (AFB), CO and the Alternate MCS (AMCS) located at Vandenberg AFB, CA, both of which include connections to the ground antenna and monitoring stations which support the Global Positioning System III (GPS III) and GPS II legacy spacecraft. Also included are the costs of operating, maintaining, and supporting seventeen monitoring stations, six controlled by the 50th Space Wing and eleven co-located at National Geo-spatial Intelligence Agency sites. Satellite operations at the MCS include mission planning, mission payload operations, and monitoring of satellite state of health. Monitor stations receive mission payload data and transfer this data to the MCS to ensure spacecraft are operating as desired.

The "system" to be supported will consist of the Master Control Station, Alternate Master Control Station, Launch and Checkout System, Transition Support Facility, Data Storage and Archive System, GPS System Simulator, Standard Space Trainer software, four ground antennae elements, and 17 remote sites.

O&S cost estimate assumes OCX Block 1 is Ready To Operate in month end July 2019, a 10 year service life for this one system which starts on August 1, 2019. Manpower assumes a mixture of Air Force personnel performing organic work with assistance from contractor engineers. The estimate assumes organic depot hardware maintenance with 30% organic software maintenance and 70% contractor software maintenance. The cost estimate also includes Software Iteration 2.2 and the O&S requirements to support GPS III Satellite Vehicle (SV) 09 and SV10.

Manpower, operations and maintenance is analogous to the currently operating GPS Operational Control System (OCS) with adjustments modeled to reflect the new OCX footprint.

Sustainment support is based on operator and non-operator training and sustainment engineering support is analogous to GPS OCS.

Continuing system improvements are factored in as hardware modifications and software maintenance and modifications. The OCX hardware and software maintenance cost are based on OCS historical data and adjusted proportionally for the larger hardware profile and Software Lines of Code and Information Assurance differences between OCS and OCX.

Contingency Operations cost is not included in the current OCX SCP O&S estimate.

## Sustainment Strategy

Hardware depot maintenance will be 100% supported by Tobyhanna Army Depot while the Organizational Level

maintenance will be Contractor Logistics Support (in alignment with operational unit's maintenance structure).

## Antecedent Information

GPS OCS is the current operating control system and is limited to operating GPS II satellites. GPS OCS costs are derived from actual cost collected from the last GPS OCS official Cost Data Summary Report submission in 2011.

| Annual O&S Costs BY2012 $M | | |
|---|---|---|
| **Cost Element** | **OCX Average Annual Cost Per System** | **GPS Operational Control System (OCS) (Antecedent) Average Annual Cost Per System** |
| Unit-Level Manpower | 16.800 | 12.100 |
| Unit Operations | 9.500 | 51.400 |
| Maintenance | 46.500 | 5.400 |
| Sustaining Support | 2.800 | 4.400 |
| Continuing System Improvements | 51.900 | 31.500 |
| Indirect Support | 3.300 | 0.500 |
| Other | 1.300 | 0.000 |
| Total | 132.100 | 105.300 |

The estimated GPS OCX average annual cost is higher than the GPS OCS actuals mainly due to the following significant cost drivers; OCX has a significantly more lines-of code (57% larger) to maintain, a significantly more complex and robust Information Assurance (IA) construct, and higher costs for hardware maintenance due to a larger hardware profile (76% larger). Lastly, the Manpower Estimate Report (used estimate unit manning) has been updated with an addendum to more accurately reflect program requirements.

* Other: Costs under this category are linked to Depot Stand-Up.

| Item | Total O&S Cost $M | | | |
|---|---|---|---|---|
| | OCX | | | GPS Operational Control System (OCS) (Antecedent) |
| | Current Development APB Objective/Threshold | | Current Estimate | |
| **Base Year** | 1321.0 | 1321.0 | 1321.0 | N/A |
| **Then Year** | 2066.1 | N/A | 2065.7 | N/A |

## Equation to Translate Annual Cost to Total Cost

Average Annual Cost per system = Total OCX O&S Cost / number of service years

$132.1M= $1,321.0/10

| O&S Cost Variance |
|---|

| Category | BY 2012 $M | Change Explanations |
|---|---|---|
| Prior SAR Total O&S Estimates - Dec 2014 SAR | 1597.1 | |
| Programmatic/Planning Factors | -276.1 | Reduction of service life of the program from 12 years to 10. |
| Cost Estimating Methodology | 0.0 | |
| Cost Data Update | 0.0 | |
| Labor Rate | 0.0 | |
| Energy Rate | 0.0 | |
| Technical Input | 0.0 | |
| Other | 0.0 | |
| Total Changes | -276.1 | |
| Current Estimate | 1321.0 | |

## Disposal Estimate Details

**Date of Estimate:**

**Source of Estimate:**

**Disposal/Demilitarization Total Cost (BY 2012 $M):**

OCX disposal costs will be finalized in support of Milestone C.